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ABSTRACT

This document provides evaluation data for the "Mathematics Laboratories for Disadvantaged Students" project. The project was designed to provide mathematics instruction for under-achieving students in grades 5-8. The mathematics laboratory was used by each student for one hour per day five days a week. Each student had his own schedule and progressed at his own rate. Evaluation data obtained for 1973-74 and 1974-75 indicated students in all grades (approximately 200 students) involved averaged gains exceeding one year grade equivalency per year on the Comprehensive Tests of Basic Skills (CTBS). Student attendance also was improved during the time the project was in operation. The results of the evaluation were validated by a state validation team. (RH)

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Program Area: Mathematics - Grades 5-8

I. Project Title: Math Laboratories for Disadvantaged Students

II. Location: Honea Path Middle School
Anderson County School District #2
Honea Path, South Carolina 29654

School Principal - M. J. Bobo
Project Director - Dr. Marvin Woodson, Jr.
Superintendent - W. E. Sanford
Teachers - Mary Susan Johnson - Grades 5-6
- Sandra Rogers - Grades 7-8
Aides - Nancy Brock - Grades 5-6
- Sallie Foster - Grades 7-8

III. Source and Level of Funding: Title III, ESEA and local

FY 1973	2 labs	(Federal-Title III)	FY 1976	2 labs	(Title I & Title III)
FY 1974	2 labs	(Federal-Title III)	FY 1977	1 lab	(Title I)
FY 1975	2 labs	(Federal-Title III)			

The project is currently being operated with Title I ESEA funds. One lab is in operation and serves grades 6-8.

IV. Program Start Date: July 1, 1972

V. Brief Description of Project:

1. Goals and Objectives: The purposes of the project include improving the mathematics achievement and school attendance of deprived students. These expected student changes were to result from exposing the students to mathematics instructional materials that were produced and refined as a part of the project. Inservice training of the project teachers and other teachers in the district in the use of the project's experimental materials was an integral part of the project. A disadvantaged student, for the purposes of this project, was defined as a pupil scoring below the 40th percentile on the math subtest of the Stanford Achievement Test. Mentally Handicapped students were excluded.

As a result of the state validation team's on-site visit, three objectives for FY 74 were validated. They were:

a. To raise, during one school year, the average mathematics achievement level of 125 seventh and eighth grade disadvantaged students by eight months during the second year of the project's operation as measured by the total math score of the Comprehensive Tests of Basic Skills administered in early September as a pre-test and in early May as a post-test.

b. To raise, during one school year, the average mathematics achievement level of 125 fifth and sixth grade disadvantaged students by eight months during the second year of the project's operation as measured by the total math score of the Comprehensive Tests of Basic Skills administered in early September as a pre-test and in early May as a post-test.

c. To increase the average number of days in attendance of 250 fifth through eighth grade disadvantaged students over the average of the baseline data as gathered prior to the beginning of this project (1971-1972 school year) and as measured by a statistical comparison using a t-test at a significance level of .05.

2. Context: Anderson County School District # 2 is one of five school districts in Anderson County and has an enrollment of approximately 3,900 students. During the 1972-73 school year, the expenditure per child from state and local sources was $519.00. Approximately $100.00 per student was received from Federal sources. Honea Path Middle School, in which the project was implemented, has a student population of 560 pupils in grades five through eight. A major portion of the school plant is very old and in need of replacement. The school offers a curriculum which includes pre-vocational education, physical education, and programs for educably mentally handicapped and emotionally handicapped.

3. Program Description: To accomplish the stated objectives, two mathematics laboratories were established, one to serve 125 fifth and sixth grade pupils, and one to serve 125 seventh and eighth grade pupils. The teachers and aides were given ample time for planning in order to develop, refine, and perfect materials to be used in the laboratory.

The project staff, with the aid of the project consultant, developed a set of curriculum materials consisting of a teacher's management guide, five curriculum booklets, and a math lab activity booklet. These materials are available from the producing district at a cost of $10.00 per set.

Other materials needed by a consuming district are listed in the following section under "Costs."

Each year, 250 students in grades five through eight were selected to participate. Students selected for participation continued in the project until they completed the eighth grade or left the school for some other reason. Each year of the project, new participants were chosen from the school's fifth grade. Vacancies in grades 6-8 caused by transfer or dropout were filled by other qualified students.

Both laboratory teachers had five classes of twenty-five students each. The students were participants in the regular curriculum during the time they were not in the math labs. Each teacher was assisted by one aide. The laboratories were regular classrooms which had been painted in attractive colors and equipped with such things as a calculator, a cassette tape recorder, commercial mathematics kits, and tables and chairs. Each student spent one hour per day, five days per week in the math lab. The curriculum was designed specifically for the individual students. The lab utilized five techniques: math lab activities, games and puzzles, drill and practice, individual instruction and small group instruction. Each student had a schedule which he followed, and knew in advance what his schedule would be. The following points cover the methodology employed in the laboratories.

-Each student progresses at his own rate.
-There is always a variety of activities available in each laboratory.
-Many suitable materials were purchased and developed and are readily available.
-Much individual attention is given to each student.
-Math concepts are developed by manipulation objects.
-The math lab activities are success-oriented.
-Failure is kept at a minimum.
-Teachers study the habits of students in order to be able to properly motivate pupils.
-Planning time for the teacher and aide is provided and considered vital.
-Inservice training plays a vital role.
-The project consultant works in the classroom with the teachers and aides.

Two weeks of pre-service training and curriculum materials development prior to the beginning of the first project year constitute a necessary part of the project. Monthly inservice activities are also necessary for purposes of coordination and the development and revision of the instructional materials and math games.

4. Costs: Although the project was implemented with personnel, materials, and equipment, and other cost factors which were above the normal budget allocation for the producer's school district, it appears that the concept can be continued here, or adopted by a consumer district, at a minimal cost above normal operational expenses. Since the math laboratory concept falls under the supervision of the regular school principal, additional management costs would include only the pre-service and inservice activities. These costs would include in the initial year, teacher pay for two weeks prior to the beginning of the school year and the fee and travel expense for a mathematics curriculum specialist for eight days. The latter cost would be obviated if the district's staff includes such a specialist.

In the costs for start-up listed in the application, and verified by the validator, the major item was for the acquisition of personnel. Implementation of this project in a typical school, however, would not require additional teaching personnel. It would require that the instructional organization be departmentalized by subject area. The project recommends a class ratio of twenty-five pupils/teacher and aide. This figure per teacher is only slightly lower than that adherred to by most state-supported schools, and therefore, would require little additional expenditure in terms of a teacher allocation. The cost of the aide, a position deemed critical to this type of instructional mode, would be an additional, and recurring expense.

Materials such as math games, puzzles, weight sets, Cloudburst of Math Lab Experiments, metric system materials, geo-boards, Cuisinaire rods and a variety of consumable materials are necessary. The project provided $600 for these materials. Equipment such as an electronic calculator, cassette recorder, filing cabinets and instructional tapes are also required The project provided $2,500 for this equipment. First year per pupil cost was approximately $60, including teacher aide, equipment, supplies and inservice expenses.

Continuation costs would include 2-3 days of preservice training and the replacement of consumable materials. The cost of these materials is estimated at $2.00 per student.

VI. Evidence of Effectiveness

Participants-A total of 250 students in grades five through eight was selected to participate on the basis of their Stanford Achievement Test matematics subtest scores. All the students scored at or below the 40th percentile in their classes, but they were not special education students. One hundred and twenty-five fifth and sixth grade students were assigned to one math teacher and 125 seventh and eighth grade pupils were assigned to another math lab teacher. This arrangement allowed each teacher to teach five classes each with an enrollment of twenty-five students per class. Fifth and sixth graders were assigned to one teacher and seventh and eighth graders to another teacher because in so doing the preparation time for each was minimized and because a teacher is probably more effective when dealing with relatively homogeneous as opposed to more heterogeneous students.

Controls-A comparison group was selected from grades seven and eight in another school in the district. Both schools served communities having similar socio-economic characteristics, offered similar educational programs, had similar educational policies, and were alike in other relevant factors. The student in the control group were matched as closely as possible to project students on the basis of age, race, sex, and pre-achievement level of the Stanford Achievement Test. As an added precaution, the principal, the teachers and the students in the comparison school were not aware that a comparison group had been selected, and the selection test data for them were taken from the regular testing program of the district. The control subjects were tested in such a manner they did not know that they were in any way involved in the project. The principal of their school had expressed concern about the achievement of his students and the Assistant Superintendent suggested that some special testing might serve as the basis for implementing some special program in his school. The principal agreed and the control subjects were tested at the same time as the treatment subjects. No control group students were selected from the fifth and sixth grades because the only other school in the district that housed these grades also had a special math program in progress in these grades.

Students selected to participate in the project scored below the 40th percentile on the Stanford Achievement Test, and their progress during the project was measured by the Comprehensive Tests of Basic Skills. This procedure minimized the confounding effects of regression to the mean on final test scores.

The testing was under the direct supervision of the district guidance/testing coordinator, and the validation team was convinced that every possible precaution had been made to administer and score the tests in strict accordance with publisher's instructions.

Test Controls-A matched comparison group which was unaware of being observed, the use of different instruments for selection of students and evaluation, the simultaneous testing of project and comparison students under identical conditions, and the close supervision of the testing without disrupting the usual school routine, assured that the data collected were as reliable as can be realistically expected in a public school setting. The controls and design employed

also minimized threats to internal validity including regression to the mean, differential selection, history, and maturation.

Test Selection-The Comprehensive Tests of Basic Skills (CTBS) was selected as an appropriate evaluation instrument because it possesses content validity for this project. During the planning stage of the project, mathematics teachers from grades five through eight spent two full days in inservice activities determining the purpose and content of math curriculum for these grades. As a result of this activity, teachers reached an agreement as to which math concepts should be taught to the district's children and in what sequence. The evaluator, who had been present for the inservice, then compared this scope and sequence to the CTBS, matching them item by item to assure adequate coverage. In his opinion, the CTBS items and instructional objectives of the project were congruent, and confidence in the results obtained by the CTBS was increased.

The math portion of the Comprehensive Test of Basic Skills (CTBS) Form Q, Level II was administered to the fifth and sixth grade project participants as both the pre and the posttest Form Q, Level III was administered to the seventh and eighth grade project participants as both the pre and posttest.

The standard errors of measurement for CTBS/Q Level II at the 5th and 6th grades are, respectively, .34 and .37. For CTBS/Q Level II at the 7th and 8th grades, the standard errors of measurement are, respectfully, .45 and .49.

Data Collection and Analysis-During the project year 1973-74 pre and posttest data were gathered in September and May for project participants in all four grades and for control group students in grades 7 and 8 by administering the CTBS as described earlier. During the project year 1974-75, test data were gathered in the same manner except that no control group was utilized. Attendance data were obtained from school records.

The findings pertaining to each objective are given below.

a. To raise, during one school year, the average mathematics achievement level of 125 seventh and eighth grade disadvantaged students by eight months during the second year of the project's operation as measured by the total math score of the Comprehensive Tests of Basic Skills administered in early September as a pretest and in early May as a posttest.

In September, 1973, the mean grade equivalency for the 7th and 8th grade participants was 4.733. In May, 1974, the mean was 6.047. The difference of 1.314 by far exceeds the .8 specified in the objective. These findings are based on 103 students.

In September, 1974, the mean for the 7th and 8th grade participants was 4.758 and in May, 1975, it was 5.931. The difference of 1.173 by far exceeds the .8 specified in the objective. These findings are based on 104 students.

These findings support the effectiveness of the project but in the project year 1973-74 additional support is given from a comparison of the treatment and control groups in the 7th and 8th grades. There were 89 matched pairs of treatment and control subjects for whom there were both pre and posttest scores. The two groups had identical pretest mean grade equivalencies of 4.75. The posttest mean of the treatment group was 6.06 while that of the control group was 5.49. The difference of .57 is associated with a t value of 3.45, which has a one-tail probability of less than .001.

That the 89 treatment subjects used in this analysis represent all students in the project in these grades is evidenced by the extreme closeness of the pre and posttest means of these 89 as compared to those of the 103 reported earlier. The pretest means are 4.75 and 4.73, respectively, and the posttest means are 6.06 and 6.05, respectively.

b. To raise, during one school year, the average mathematics achievement level of 125 fifth and sixth grade disadvantaged students by eight months during the second year of the project's operation as measured by the total math score of the Comprehensive Test of Basic Skills administered in early September as a pretest and in early May as a posttest.

In September, 1973, the mean grade equivalency of the 5th and 6th grade project participants was 4.068. In May the mean was 5.945. The difference of 1.877 by far exceeds the .8 specified in the objective. This finding is based on 100 students.

In September, 1974, the mean grade equivalency of the 5th and 6th grade participants was 4.271, while the mean in May, 1975, was 5.978. The difference of 1.707 by far exceeds the .8 specified in the objective. This finding is based on 106 students.

The evidence of effectiveness for objectives a. and b. for both years is compelling.

c. To increase the average number of days in attendance of 250 fifth through eighth grade disadvantaged students over the average of the baseline data as gathered prior to the beginning of this project (1971-72) school year) and as measured by a statistical level of .05.

The attendance records of the 1973-74 project participants were examined. During the school year 1971-72, the mean number of days present was 160.8, while during the project year, the mean was 165.7. The difference of 4.9 is associated with a t value of 5.49 which has a one-tail probability of less than .0005.

This by far exceeds the specification in the objectives. This finding is based on 200 students.

The state validation team considered only the data given above for the second year of the project, i. e., 1973-74. The third year data were not available for analysis at the time the team visited the project in May, 1975, but the achievement data for the third year have been included in this report to show that the positive evaluation results for the project year 1973-74 were not artifactual.

The results, which were state validated, were submitted to the Joint Dissemination and Review Panel (JDRP) in the Office of Education for possible national validation. In July 1976 the panel reviewed all evidence of effectiveness and approved the project for national validation.

VII. Further Evidence of Effectiveness:

Another way of examining the achievement data is by means of a norm-referenced evaluation model. This model makes the assumption that if a group of children at the time of pretesting performs at, for example, the ninth national percentile, the group at the time of posttesting will perform at the ninth national percentile unless some instructional intervention causes the children to perform at a higher level. Use of an approximation of the standard error of the expected posttest mean permits an approximate statistical test of the difference between the expected mean and the actual posttest mean.

The application of this model to the data by grade for the two years 1973-74 and 1974-75 yielded the following results. For 1973-74 the differences between the actual posttest grade equivalency means and the expected posttest means for grades 5, 6, 7, and 8 were, respectively, 1.29, 1.49, 1.27, and .86. For 1974-75, the differences were, respectively, 1.46, .95, .68, and .99. Each of these differences represent achievement over and above what would have been expected had the children not been project participants. Hence, claim is made that the project effectively caused these participating students to reach achievement levels in mathematics that they would not have attained without the project's influence.